

PRELIMINARY AMENDMENT
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area above PbaseL is Parea, the height of the top of the maximum peak of refractive index: Ptop, with respect to PbaseL is PtopH, and the peak area between the point at which the height of the elution curve from the elution starting point toward Ptop, with respect to PbaseL is 1/5 of PtopH and the point at which the height of the elution curve from Ptop toward the elution end point, with respect to PbaseL is 1/5 of PtopH is PareaM, Parea and PareaM satisfy the following relationship:

$$\text{PareaM/Parea} \geq 0.85$$

; and

(B) when thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having Rf values falling within the range of from 0.2 to 0.8 have a purity of not less than 98%.

2. The oxirane derivative according to Claim 1, wherein Parea and PareaH satisfy the following relationship:

$$\text{PareaH/Parea} \leq 0.05$$

where PareaH is the peak area between the elution starting point on a chromatogram and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH.

3. The oxirane derivative according to Claim 1, wherein the number of moles of oxirane added PtopEOmol determined by the following equation:

$$\text{PtopEOmol} = (\text{PtopMw} - \text{ROHMw}) / 44$$

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supposing that the molecular weight corresponding to the top of a peak on a chromatogram is $P_{top}M_w$ and the molecular weight of the compound ROH (in which R represents a C_{1-7} hydrocarbon group) to be used as a starting material is $ROH M_w$, satisfies the following relationship with the ratio PM_w/mn of weight-average molecular weight to number-average molecular weight of the region represented by $P_{area}M$ determined by gel permeation chromatography:

$$PM_w/mn - [1 + P_{top}EO_{mol}/(1 + P_{top}EO_{mol})^2] \leq 0.02.$$

4. The oxirane derivative according to Claim 1 or Claim 2, wherein R in the general formula (1) is CH_3 .

5. A process for the preparation of an oxirane derivative as in Claim 1 or Claim 2, which comprises reacting the compound ROH (in which R represents a C_{1-7} hydrocarbon group) with oxirane at a temperature of 50 to $130^\circ C$ and in a reaction system containing not more than 5 ppm water.

6. The process for the preparation of an oxirane derivative according to Claim 5, wherein R in the general formula (1) is CH_3 .

227. (Thrice amended) An oxirane derivative represented by the following general formula (2) prepared by aminating or carboxylating an oxirane derivative of formula (1):



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wherein R represents a C₁₋₇ hydrocarbon group; n represents an integer of from 20 to 900; X represents a C₁₋₃ hydrocarbon group or -CO(CH₂)_q- (in which q is an integer of from 2 to 4); Y represents an amino group or carboxyl group; and p represents 0 or 1, wherein said oxirane derivative of formula (1) satisfies the following requirements when subjected to gel permeation chromatography and thin layer chromatography:

D¹ (A) Supposing that the straight line between the elution starting point and the elution end point on chromatogram obtained by gel permeation chromatography is PbaseL, the total peak area above PbaseL is Parea, the height of the top of the maximum peak of refractive index: Ptop, with respect to PbaseL is PtopH, and the peak area between the point at which the height of the elution curve from the elution starting point toward Ptop, with respect to PbaseL is 1/5 of PtopH and the point at which the height of the elution curve from Ptop toward the elution end point, with respect to PbaseL is 1/5 of PtopH is PareaM, Parea and PareaM satisfy the following relationship:

$$PareaM/Parea \geq 0.85$$

; and

(B) When thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having Rf value falling within the range of from 0.2 to 0.8 have a purity of not less than 98%.

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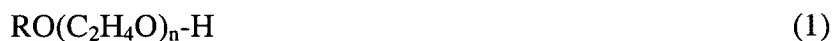
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1. The oxirane derivative according to Claim 3, wherein R in the general formula (1) is CH₃.

8. A process for the preparation of an oxirane derivative as defined in Claim 3, which comprises reacting the compound ROH (in which R represents a C₁₋₇ hydrocarbon group) with oxirane at a temperature of 50 to 130°C and in a reaction system containing not more than 5 ppm water.

9. The process for the preparation of an oxirane derivative according to Claim 8, wherein R in the general formula (1) is CH₃.

30. (Twice amended) An oxirane derivative represented by the following general formula (2) prepared by aminating or carboxylating an oxirane derivative of formula (1):



D² wherein R represents a C₁₋₇ hydrocarbon group; n represents an integer of from 20 to 900; X represents a C₁₋₃ hydrocarbon group or -CO(CH₂)_q- (in which q is an integer of from 2 to 4); Y represents an amino group or carboxyl group; and p represents 0 or 1, wherein said oxirane derivative of formula (1) satisfies the following requirements when subjected to gel permeation chromatography and thin layer chromatography:

(A) Supposing that the straight line between the elution starting point and the elution end point on chromatogram obtained by gel permeation chromatography is P_{baseL}, the total peak area above P_{baseL} is P_{area}, the height of the top of the maximum peak of refractive index: P_{top},

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with respect to PbaseL is PtopH, and the peak area between the point at which the height of the elution curve from the elution starting point toward Ptop, with respect to PbaseL is 1/5 of PtopH and the point at which the height of the elution curve from Ptop toward the elution end point, with respect to PbaseL is 1/5 of PtopH is PareaM, Parea and PareaM satisfy the following relationship:

$$PareaM/Parea \geq 0.85$$

; and

D² (B) When thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having Rf value falling within the range of from 0.2 to 0.8 have a purity of not less than 98%,

wherein the number of moles of oxirane added PtopEOmol determined by the following equation:

$$PtopEOmol = (PtopMw - ROHMw) / 44$$

supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents a C₁₋₇ hydrocarbon atom) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

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$$PM_{mw}/m_n - [1 + P_{topEO}mol/(1 + P_{topEO}mol)^2] \leq 0.02.$$

31 12. (Twice amended) An oxirane derivative represented by the following general formula (2) prepared by aminating or carboxylating an oxirane derivative of formula (1):



D² wherein R represents CH₃; n represents an integer of from 20 to 900; X represents a C₁₋₃ hydrocarbon group or -CO(CH₂)_q- (in which q is an integer of from 2 to 4); Y represents an amino group or carboxyl group; and p represents 0 or 1, wherein said oxirane derivative of formula (1) satisfies the following requirements when subjected to gel permeation chromatography and thin layer chromatography:

(A) Supposing that the straight line between the elution starting point and the elution end point on chromatogram obtained by gel permeation chromatography is P_{baseL}, the total peak area above P_{baseL} is P_{area}, the height of the top of the maximum peak of refractive index: P_{top}, with respect to P_{baseL} is P_{topH}, and the peak area between the point at which the height of the elution curve from the elution starting point toward P_{top}, with respect to P_{baseL} is 1/5 of P_{topH} and the point at which the height of the elution curve from P_{top} toward the elution end point, with respect to P_{baseL} is 1/5 of P_{topH} is P_{areaM}, P_{area} and P_{areaM} satisfy the following relationship:

$$P_{areaM}/P_{area} \geq 0.85$$

; and

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(B) When thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having Rf value falling within the range of from 0.2 to 0.8 have a purity of not less than 98%,

wherein the number of moles of oxirane added PtopEOmol determined by the following equation:

D²
$$P_{topEOmol} = (P_{topMw} - ROHMw) / 44$$

supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents a CH₃) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$PMmw/mn - [1 + P_{topEOmol} / (1 + P_{topEOmol})^2] \leq 0.02.$$

3² 14: (Amended) A process for the preparation of an oxirane derivative represented by formula (2), which comprises aminating or carboxylating an oxirane derivative of formula (1):



wherein R represents a C₁₋₇ hydrocarbon group; n represents an integer of from 20 to 900; X represents a C₁₋₃ hydrocarbon group or -CO(CH₂)_q- (in which q is an integer of from 2 to 4); Y

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represents an amino group or carboxyl group; and p represents 0 or 1, wherein said oxirane derivative of formula (1) satisfies the following requirements when subjected to gel permeation chromatography and thin layer chromatography:

D³ (A) Supposing that the straight line between the elution starting point and the elution end point on chromatogram obtained by gel permeation chromatography is PbaseL, the total peak area above PbaseL is Parea, the height of the top of the maximum peak of refractive index: Ptop, with respect to PbaseL is PtopH, and the peak area between the point at which the height of the elution curve from the elution starting point toward Ptop, with respect to PbaseL is 1/5 of PtopH and the point at which the height of the elution curve from Ptop toward the elution end point, with respect to PbaseL is 1/5 of PtopH is PareaM, Parea and PareaM satisfy the following relationship:

$$PareaM/Parea \geq 0.85$$

; and

(B) When thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having Rf value falling within the range of from 0.2 to 0.8 have a purity of not less than 98%.

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16. (Amended) A process for the preparation of an oxirane derivative represented by formula (2), which comprises aminating or carboxylating an oxirane derivative of formula (1):

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wherein R represents a C_{1-7} hydrocarbon group; n represents an integer of from 20 to 900; X represents a C_{1-3} hydrocarbon group or $-\text{CO}(\text{CH}_2)_q-$ (in which q is an integer of from 2 to 4); Y represents an amino group or carboxyl group; and p represents 0 or 1, wherein said oxirane derivative of formula (1) satisfies the following requirements when subjected to gel permeation chromatography and thin layer chromatography:

D³ (A) Supposing that the straight line between the elution starting point and the elution end point on chromatogram obtained by gel permeation chromatography is P_{baseL} , the total peak area above P_{baseL} is P_{area} , the height of the top of the maximum peak of refractive index: P_{top} , with respect to P_{baseL} is P_{topH} , and the peak area between the point at which the height of the elution curve from the elution starting point toward P_{top} , with respect to P_{baseL} is 1/5 of P_{topH} and the point at which the height of the elution curve from P_{top} toward the elution end point, with respect to P_{baseL} is 1/5 of P_{topH} is P_{areaM} , P_{area} and P_{areaM} satisfy the following relationship:

$$P_{\text{areaM}}/P_{\text{area}} \geq 0.85$$

; and

(B) When thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having R_f value falling within the range of from 0.2 to 0.8 have a purity of not less than 98%,

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wherein the number of moles of oxirane added PtopEOmol determined by the following equation:

$$\text{PtopEOmol} = (\text{PtopMw} - \text{ROHMw}) / 44$$

D³ supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents a C₁₋₇ hydrocarbon atom) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$\text{PMmw/mn} - [1 + \text{PtopEOmol} / (1 + \text{PtopEOmol})^2] \leq 0.02.$$

Add claims 16-43 as follows.

13 16. (New) The oxirane derivative according to Claim 1, wherein PareaM/Parea is not less than 0.88.

D⁴ 16 17. (New) The oxirane derivative according to Claim 1, having a thin layer chromatography purity of not less than 99%.

17 18. (New) The oxirane derivative according to Claim 1, wherein n is from 50 to 900.

18 19. (New) The oxirane derivative according to Claim 1, wherein n is from 100 to 900.

19 20. (New) The oxirane derivative according to Claim 1, wherein R in general formula (1) is a C₇ hydrocarbon group.

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10 ~~21~~. (New) The oxirane derivative according to Claim 2, wherein PareaH/Parea is not more than 0.04.

11 ~~22~~. (New) The process for the preparation of an oxirane derivative according to Claim 5, which comprises reacting the compound ROH (in which R represents a C_{1-7} hydrocarbon group) with oxirane in the presence of a catalyst selected from the group consisting of metallic sodium, metallic potassium and an alkoxide of compound ROH.

D4 12 ~~23~~. (New) The process for the preparation of an oxirane derivative according to Claim 6, which comprises reacting the compound ROH (in which R represents CH_3) with oxirane in the presence of a catalyst selected from the group consisting of metallic sodium, metallic potassium and an alkoxide of compound ROH.

13 ~~24~~. (New) The process for the preparation of an oxirane derivative according to Claim ~~8~~⁹, which comprises reacting the compound ROH (in which R represents a C_{1-7} hydrocarbon group) with oxirane in the presence of a catalyst selected from the group consisting of metallic sodium, metallic potassium and an alkoxide of compound ROH.

14 ~~25~~. (New) The process for the preparation of an oxirane derivative according to Claim ~~10~~⁹, which comprises reacting the compound ROH (in which R represents CH_3) with oxirane in the presence of a catalyst selected from the group consisting of metallic sodium, metallic potassium and an alkoxide of compound ROH.

23 ~~26~~. (New) The oxirane derivative according to Claim ~~7~~²², wherein Parea and PareaH satisfy the following relationship:

$$\text{PareaH/Parea} \leq 0.05$$

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where PareaH is the peak area between the elution starting point on a chromatogram and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH.

24. (New) The oxirane derivative according to Claim ²² 1, wherein R is CH₃.

25. (new) The oxirane derivative according to Claim ²² 1, wherein Parea and PareaH satisfy the following relationship:

$$\text{PareaH}/\text{Parea} \leq 0.05$$

D⁴ where PareaH is the peak area between the elution starting point on a chromatogram, and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH and the number of moles of oxirane added PtopEOmol determined by the following equation:

$$\text{PtopEOmol} = (\text{PtopMw} - \text{ROHMw}) / 44$$

supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents a C₁₋₇ hydrocarbon group) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$\text{PMmw}/\text{mn} - [1 + \text{PtopEOmol}/(1 + \text{PtopEOmol})^2] \leq 0.02.$$

26. (new) The oxirane derivative according to Claim ²² 1, wherein R is CH₃,

Parea and PareaH satisfy the following relationship:

$$\text{PareaH}/\text{Parea} \leq 0.05$$

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where PareaH is the peak area between the elution starting point on a chromatogram, and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH and the number of moles of oxirane added PtopEOmol determined by the following equation:

$$P_{topEOmol} = (P_{topMw} - ROHMw) / 44$$

supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents CH₃) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$PMmw/mn - [1 + P_{topEOmol} / (1 + P_{topEOmol})^2] \leq 0.02.$$

^{D4}
~~33~~³⁰. (New) The process according to Claim ~~14~~³², wherein Parea and PareaH satisfy the following relationship:

$$P_{areaH} / P_{area} \leq 0.05$$

where PareaH is the peak area between the elution starting point on a chromatogram and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH.

~~34~~³¹. (New) The process according to Claim ~~14~~³², wherein R is CH₃.
~~35~~³². (New) The process according to Claim ~~14~~³², wherein Parea and PareaH satisfy the following relationship:

$$P_{areaH} / P_{area} \leq 0.05$$

where PareaH is the peak area between the elution starting point on a chromatogram, and

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the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH and the number of moles of oxirane added PtopEOmol determined by the following equation:

$$P_{topEOmol} = (P_{topMw} - ROHMw) / 44$$

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supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents a C₁₋₇ hydrocarbon group) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$PMmw/mn - [1 + P_{topEOmol} / (1 + P_{topEOmol})^2] \leq 0.02.$$

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(New) The process according to Claim 14, wherein R is CH₃, and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH and the number of moles of oxirane added PtopEOmol determined by the following equation:

$$P_{topEOmol} = (P_{topMw} - ROHMw) / 44$$

supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents C₃) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$PMmw/mn - [1 + P_{topEOmol} / (1 + P_{topEOmol})^2] \leq 0.02.$$

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~~37~~ ³⁴. (New) The process according to Claim ~~14~~, wherein R is CH₃, Parea and PareaH satisfy the following relationship:

$$\text{PareaH/Parea} \leq 0.05$$

where PareaH is the peak area between the elution starting point on a chromatogram, and the point at which the height of the elution curve toward Ptop from PbaseL is 1/5 of PtopH and the number of moles of oxirane added PtopEOmol determined by the following equation:

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$$\text{PtopEOmol} = (\text{PtopMw} - \text{ROHMw}) / 44$$

supposing that the molecular weight corresponding to the top of a peak on a chromatogram is PtopMw and the molecular weight of the compound ROH (in which R represents CH₃) to be used as a starting material is ROHMw, satisfies the following relationship with the ratio PMmw/mn of weight-average molecular weight to number-average molecular weight of the region represented by PareaM determined by gel permeation chromatography:

$$\text{PMmw/mn} - [1 + \text{PtopEOmol}/(1 + \text{PtopEOmol})^2] \leq 0.02.$$

²²
~~27~~ ³⁵. (New) The oxirane derivative according to Claim ~~7~~, wherein n is from 50 to 900.

²²
~~28~~ ³⁶. (New) The oxirane derivative according to Claim ~~7~~, wherein n is from 100 to 900.

²²
~~29~~ ³⁷. (New) The oxirane derivative according to Claim ~~7~~, wherein R is a C₇ hydrocarbon group.

³²
~~38~~ ³⁸. (New) The process according to Claim ~~14~~, wherein n is from 50 to 900.

³²
39. (New) The process according to Claim ~~14~~, wherein n is from 100 to 900.

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40. (New) The process according to Claim 14, wherein R is a C₇ hydrocarbon group.

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41. The oxirane derivative according to Claim 1, wherein R represents a C₁₋₄ hydrocarbon group.

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42. The oxirane derivative according to Claim 1, wherein R represents a C₁₋₂ hydrocarbon group.

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43. (New) An oxirane derivative represented by the following general formula (1):



wherein R represents a C₁₋₇ hydrocarbon group; and n represents an integer of from 50 to 900, said oxirane derivative of formula (1) is prepared by reacting ROH with oxirane at a temperature of from 50 to 130°C in a reaction system having a water content of not more than 5 ppm, and wherein said oxirane derivative of formula (1) satisfies the following requirements when subjected to gel permeation chromatography and thin layer chromatography:

(A) Supposing that the straight line between the elution starting point and the elution end point on chromatogram obtained by gel permeation chromatography is PbaseL, the total peak area above PbaseL is Parea, the height of the top of the maximum peak of refractive index: Ptop, with respect to PbaseL is PtopH, and the peak area between the point at which the height of the elution curve from the elution starting point toward Ptop, with respect to PbaseL is 1/5 of PtopH and the point at which the height of the elution curve from Ptop toward the elution end point, with respect to PbaseL is 1/5 of PtopH is PareaM, Parea and PareaM satisfy the following relationship:

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$\text{PareaM/Parea} \geq 0.88$

; and

DY (B) When thin layer chromatography is effected by development with a 85 : 15 (by volume) mixture of chloroform and methanol, followed by color development with iodine and measurement of the purity of various spots by a densitometer, main spots having Rf value falling within the range of from 0.2 to 0.8 have a purity of not less than 98%.
